U. S. ARMY ELECTRONICS COMMAND

Fort Monmouth, New Jersey

SEACORE

SOUTHEAST ASIA COMMUNICATIONS RESEARCH

SPONSORED BY ARPA

USAECOM SERVICE AGENT

SEMI-ANNUAL REPORT NO. 5

1 AUGUST 1964 – 31 JANUARY 1965

HEADQUARTERS
UNITED STATES ARMY ELECTRONICS COMMAND
FORT MONMOUTH, NEW JERSEY 07703

IN REPLY REFER TO
AMSEL-NL-R-4

SUBJECT: United States Army Electronics Command Semi-Annual Report Number 5 on ARPA Order 371 for period ending January 1965

TO: Director
Advanced Research Projects Agency
Washington 25, D. C.

Order Number

371, Amendments 1, 2, 3, 4, 5, 6, 7, 8, 9

Project Officer

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Telephone: Area Code 201
Number: 53-51565

Program Code - Name

2860 - SEACORE

Short Title of Work

Tropical Military Communications

Contractor	Number	Date	Amount
Jansky & Bailey	DA36-039 SC-90889	29 June 62	$3,233,903.00
Stanford Research Inst.	DA36-039 AMC-00040(E)	31 Aug. 62	2,553,285.00
ITT Federal Laboratories	DA36-039 AMC-03736(E)	20 Dec. 63	51,930.00
Radio Corp. of America	DA 28-043 AMC-00090(E)	1 May 64	215,000.00
Collins Radio Co.	DA28-043 AMC-00863(E)	4 May 64	10,780.50
Rolligon Corp.	DA28-043 AMC-00359(E)	4 Aug 64	73,664.86
Sprague Electric Co.	DA28-043 AMC-00890(E)	30 Nov 64	18,2,2.61
		TOTAL	$6,156,795.97

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1. SEACORE Objectives

ARPA Order 371 and its amendments provide guidance for the South East Asia Communications Research (SEACORE) program designed to meet the following objectives:

a. Field tests shall be conducted in Thailand to obtain basic propagation data in the different tropical environments.

b. The different types of tropical environment shall be identified in relation to the electromagnetic properties.

c. The technical difficulties shall be identified which are detrimental to military communications in the tropical environment.

d. Equipment, techniques and new ideas shall be tested in the tropical environment as directed.

e. Guidance for future R&D programs shall be developed.

f. Technical assistance shall be given to the Thailand government thru the MRDC, Bangkok.

g. The findings in Thailand shall be checked by field tests in tropical environments elsewhere in the world so that the conclusions and guidance is applicable world wide in any tropical environments.

h. Survey, analyze and evaluate the capacity, reliability, and physical and tactical limitations of existing communications equipments and techniques.

i. Generate from the results of the survey a set of requirements for field communications based upon tactical considerations and specify equipment characteristics which will satisfy these requirements.

j. Test of the shelf equipments that come as close as possible to satisfying each set of the above requirements: these tests to be first technical and tactical for items which show promise.

k. Analyze and evaluate the tests and recommend areas for future emphasis.

l. State equipment requirements to accomplish the task of jungle field communications based upon existing and anticipated tactical requirements, including requirements for development items, as determined by the preceeding efforts.

m. Train the Thai personnel assigned to the SEACORE Laboratory so that they are able to utilize the facility; accomplishing this training as a natural course of operating the laboratory.

n. Aid electronic projects as practical, encouraging such projects as appear especially useful to the basic objectives of MRDC.

2. Method of Approach

Two prime contractors, Jansky & Bailey Co. and Stanford Research Institute, were selected to perform the research work in Thailand. Many other contracts were placed to provide equipment and services to support the work of the two prime contractors. Captain Kenneth Irish was assigned duty station in Bangkok to represent the U. S. Army Electronics Laboratories and was appointed Contracting Officer's Technical Representative (COTR) to provide technical direction and assistance to the contractor people operating in Thailand.

3. Contract Status

a. Tropical Propagation Studies
Contract DA 36-039 SC-90889
Jansky & Bailey Division of Atlantic Research Corporation

1. Discussions with ARPA and others involved in SEACORE indicated a desirability of extending the propagation measurements and investigations up through frequencies as high as 10 gigacycles for certain specific modes of propagation. Specifically, within this extended frequency range, it was desirable to investigate the propagation characteristics of line-of-sight paths over jungle terrain, and of short range radar paths immersed in jungle foliage.

A meeting, to this effect, was held at ARPA 3 September 1964 with Jansky & Bailey and USAECOM personnel, at which time the Jansky & Bailey proposed test plan for the technical effort covering the frequency range of 400 up to 10 gc was discussed in detail. The modifications to the plan discussed and agreed upon by ARPA, J&B and USAECOM personnel were incorporated into a J&B final test plan which was submitted to the Contracting Officer and was approved September 1965.

A measurement system for propagation tests in the frequency range (425 to 10 gc) was developed by Jansky & Bailey. An analysis of the measurement program and its objectives wasamade to develop system requirements including such factors as frequency stability, maximum expected transmission attenuation, antenna positioning, terrain profile, and measurements site locations. A survey was made to locate the various system components which could be used. In this process it was necessary to consider the contribution of each component to the overall system performance. Transmitter power output, antenna gains, transmission line losses and receiver sensitivity were combined and compared to maximum expected attenuations over the entire frequency range. Additionally, the antenna directivity was considered in terms of mounting stability requirements and the final antenna selection must be based on the system gain

requirements and tower stability characteristics. In addition to the main system components other equipment was selected to calibrate and maintain the accuracy of the measuring equipment.

Approximately 90% of the special test equipment required for this effort was received at Alexandria where it was assembled, calibrated and test operated into dummy loads. Personnel were familiarized with the operation of the equipment and a logistics program was initiated.

2. By aerial survey, a second test site in Thailand was tentatively chosen in the existing ARPA RDFU test area near Hua Hin on the southeast penisula of Thailand. A ground survey of the area indicated that it would be inadequate. Search for an adequate site is continuing.

3. The introductory Film Report "Science versus Subversion" with English narration was completed and approved. A Thai narration was written based on material received from Major General Singchai Menasuta. This Thai narration was reviewed and approved by General Singchai and ARPA. A review of the Technical film "Defense Communications Research in Thailand" was held in October 1965 and was attended by A. Stroebele of ARPA. Script changes suggested by ARPA were made and the final release copy, submitted to ARPA, was approved. Translation of the English narration text of this film into Thai was initiated.

4. A computer program to predict the theoretical basic transmission loss over test paths from 20 to 245 megacycles was completed and checked out. Using this program several basic transmission losses were used in conjunction with actual measured data to obtain foliage attenuation curves.

5. During this period, a draft of J&B Semi-Annual Report Nr. 4 for the period 31 January to 31 July 1964 was approved by USAECOM and printed copies of the report were distributed to the various agencies. A draft of Semi-Annual Report Nr. 5 was submitted for approval.

6. Trail conditions became worse due to the rainy season (Fig. III - V). For the height gain measurements, a 3/4 ton truck in lieu of the Nissan was used. The sealed ignition and greater clearance of the 3/4 ton truck gave this vehicle a decided advantage over the Nissan (Fig VI) during the wet trail conditions.

7. During September, trail conditions worsened to the extent that the Nissans became completely useless, and were replaced with Land Rovers to conduct field measurements. Equipment consoles were constructed for the Land Rovers, offering the option of selection of between 12 volt - 120 volt inverter and external gasoline generators. There is a built in battery charger for use with 110 volts as well as built in power metering circuits, provision for 12 volt electrical system measurements, and a Variac voltage control. All cables are brought out to a connector panel at the rear of the vehicle. In addition, new radomes, more rugged than those used in

the past, were constructed. Floods, during October, completely washed out one bridge and moved another 10 ft. down stream. The remainder of the bridges are usable although some of the approaches are in bad condition.

7. All outstanding Radial A field measurements data and a completed set of Radial B tower measurements for the 25.5 to 400 mc frequency range were completed and sent to Alexandria, Virginia for processing. Trail construction of the Radial B was initiated 17 September 1964 and completed from the J&B camp site. Through experience collection of data has now become routine.

8. Satisfactory helicopter service to the Jansky & Bailey camp site was restored effective 22 January 1965. ARPA has completed contract arrangements with Air American for one day a week service and other times upon request. Prior to this arrangement helicopter service was provided by the Royal Thai Air Force which proved unsatisfactory due to scheduling difficulties.

b. Tropical Communications
Contract DA36-039 AMC-00040(E)
Stanford Research Institute

1. SRI was advised of the ARPA decision not to continue the Task I portion of the contract beyond the present funding. The program for Task I was reviewed and a revised program statement by Stanford Research Institute for the balance of Task I work was submitted to ARPA and USAECOM with the necessary revisions in the schedule and changes in the assignment of personnel. In addition SRI has requested the Contracting Officer for an extension of Task I termination date from 31 March 1965 to 30 June 1965, at no added cost, to complete the program as revised.

2. Final - Report - Volume I covering the period 1 September 1962 thru 29 February 1964 has been distributed.

3. Data was accumulated on noise levels at VHF frequencies and all factors in Thailand that might affect the choice of low-noise measurement sites. R-390 receivers were used to spot monitor radio noise and flash count data was collected on a lightning flash counter. A low noise site survey was completed and recommendations for a specific site were made. A memorandum entitled "Selection of MRDC Low-Noise Field Site" was forwarded to the Bangkok COTR. Tentative plans were completed to start construction of a short access road and concrete pad pending approval by MRDC. Construction of the ARN-3 type noise measuring equipment, required to obtain key data, is pending on action of SRI proposal ELU 64-140.

4. 1000 most frequently used Thai words were translated into phonetic notations and analyzed. From these analysis statistical characteristics of spoken Thai were determined for use as guidelines for the construction of work lists to be used in intelligibility testing. From this analysis five different forms of intelligibility tests of 50 item word lists were completed.

All forms were very similar in phoneme and tone composition. The tests were recorded by three speakers and presented to a group of Thai listeners. Test responses from this group were used for selecting the recorded versions of the test to be employed in subsequent testing. These recordings were subjected to various filters to determine the effects of filtering on Thai intelligibility. English intelligibility test tapes were also processed over the same configuration. Tests were presented to English subjects, Thai students attending Stanford University, and members of the Thai armed services. These tests served to provide a basis of relative comparison on English and Thai intelligibility as well as the reaction of two Thai populations. Results of the tests have been tabulated and the data is being reviewed.

5. In the test and evaluation of tactical communication techniques and devices, a draft report entitled "Field Tests of VHF Man-Pack Radios" has been completed and is being revised and edited.

6. In the antenna orientation investigation, Research Memorandum 5 Revised entitled "Orientation of Linearly Polarized HF Antennas for Short-Path Communication via the Ionosphere near the Geomagnetic Equator" and Special Technical Report 9 entitled "Absorption of Ionospherically Propagated HF Radio Waves under Conditions Where the Quasi-Transverse (QT) Approximation is Valid" have been completed and distributed by the contractor.

7. A review of those factors associated with forests important to the determination of received signal-to-noise in high frequency communications was conducted and an implementation plan for the program of the effects of tropical environment on antenna performance was completed and submitted to USAECOM. Using the Xeledop (fig VII) measurement of full-scale tactical antenna patterns over flat terrain near Lodi, California were completed. Contour plots for selected tactical antennas including dipoles, whips slant-wire, and L type antennas have been completed where the antennas were installed over smooth terrain. Analysis of the pattern effect on communications has been initiated.

c. DED Digital Encoder/Decoder
Contract DA-36-039-AMC-03736
ITT Federal Laboratories

The above contract was awarded to ITT Federal Laboratories, 20 December 1963 for two (2) each Digital Encoder/Decoder (DED) units. Two (2) units, which have been received from the contractor, are being subjected to test and evaluation at USAECOM. This unit (fig VIII) is an electro-mechanical device operating by means of two pulsed audio tones within the voice frequency audio band width of the radio with which it is being used.

This unit weights 6.5 pounds and measures 9 x 6 x 3-1/4 inches. It operates when digits to be transmitted are set into the unit by means of a phone dial. Sequencing from one digit to the next is automatic. On transmit, a free running multi-vibrator pulses each digit from its set number down to

zero, then sequences to the next digit column. As each digit is clocked down, an audio pulse on the lower of two frequencies (f1) is transmitted. When the register is shifted, both the lower (f_1) and the higher (f_2) frequency tone pulses are transmitted. The two frequencies used are selected from a total of five as determined by the address selector switch. On receive, the audio pulse train triggers the multi-vibrator which in turn clocks each counter in turn to the correct digit. The receipt of the two different frequency pulses (f1 & f2) causes the unit to shift to the next digit register. This unit is capable of transmitting or receiving one (1) million prearranged message groups when used with a AN/PRC-10 Radio Set.

d. JMED Jungle Message Encoder/Decoder
Contract DA 28-043 AMC-00090(E)
Radio Corporation of America

This contract was awarded 1 May 1964 to Radio Corporation of America for the procurement of twenty (20) JMED units to evaluate the value of this device in Southeast Asia. This solid state communication device offers a possible solution to the problem encountered when people speaking different languages attempt to communicate with each other via radio.

This unit (Fig IX) weights 3.1 pounds and measures 6-3/4 x 3-1/8 x 1-3/4 inches. The internal construction of this unit consists of two printed major circuit boards with component modules between. The device is an electronic unit which transmits messages by means of a five (5) bit digital code, displaying the received message by either of two digital symbols in each of the five (5) display windows. An FM system, using an audio carrier, is used to transmit the series tones over the band-width. The unit operates when the symbols (either + or 0) to be transmitted are set into the unit manually by means of push buttons which shift a mask on each readout module. The mask is connected to an armature within the module. In the sensing operation, the position of the armature (up or down) increases the reluctance through one (1) sensing coil and decreases it through a second. In the setting operation, the armature is magnetically attracted to one setting coil and repulsed by a second. An internal clock generates sensing and setting pulses and also determines the rate of register shift. The output signal is 1550 cps carrier frequency, shifted at 130 cps rate for "+" symbol and at a 70 cps rate for the "0" symbol. This unit is capable of transmitting or receiving 32 prearranged message groups when used with a AN/PRC-10 or AN/PRC-25 Radio Set.

Two (2) of the units were submitted 15 December 1964 and are being subjected to test and evaluation at USAECOM. Delivery of the remaining eighteen (18) units is anticipated on or about 15 February 1965.

e. KWM-2A SSB Transceivers
Contract DA 28-039 AMC-00863 (E)
Collins Radio Co.

Contract was awarded 4 May 1964 for six (6) KWM-2A SSB Transceivers

with associated equipment. All contractual items have been delivered and shipped to Saigon, Vietnam. This contract is now completed.

f. Off Highway Vehicles
Contract DA 28-043 AMC-00359(E)
Rolligon Corporation

This procurement was initiated to provide six (6) vehicles (Fig. X - XII) capable of heavy duty transportation in areas in Southeast Asia without roads, trails, or tracks. In addition, this procurement provided for six (6) months engineering services of a company representative as follows: (1) maintenance of operation of the vehicles (2) instruction of Government personnel in maintenance and operation of the vehicles (3) advise and assist in the fabrication of attachments to the vehicles and the installation of electronic gear. Contract was awarded 4 August 1964 and two (2) of the units were shipped to Thailand 27 August 1964. The remaining four (4) units were shipped 24 October 1964. Under actual operating conditions, the vehicles were found to lack stability. Modifications to increase the stability and cross country characteristics of the units in a kit form which can be installed in the vehicles in Thailand have been suggested by the contractor. A proposal is being prepared by the contractor to include these modifications and will be submitted to USAECOM for approval.

Battery Charger
Contract DA 28-043 AMC-00890(E)
Sprague Electric Company

Contract was awarded 30 November 1964 to Sprague Electric Co. for the procurement of three (3) each solid state, constant current battery chargers, Sprague Electric Company NR R5015, including three (3) sets of performance tests and test data.

This battery charger may be connected to any source voltage between 28 and 250 volts. The source frequency may be any frequency from DC to 400 cycles per second. The output will be constant current, the current level being preset at 110, 250, 500 or 1000 milliamperes. Provisions are made to enable selection of the proper current level by authorized personnel. After the current level has been chosen, the selection device can be secured in such a manner that no unauthorized personnel can change the selection. The charger will automatically adjust its output voltage to that required to maintain constant current. Connections to the battery charger will be by means of four (4) leads, hermetically sealed into the unit. These leads may be connected to the source and battery to be charged in any manner. Regardless of the leads chosen for the source, the device will automatically decide which leads are connected to the source and make the proper internal connections. The remaining two (2) leads will then be automatically connected to the proper internal terminals; polarity correction is obtained. This charger will be designed using solid state and magnetic devices without the use of relays. Contract is progressing satisfactorily with delivery, scheduled no later than 31 May 1965.

4. Ionospheric Vertical Sounder in Bangkok

The measurements were accomplished by military personnel of the U. S. Army Radio Propagation Agency under the cognizance of Captain Irish. Special analysis of the data will be accomplished by Stanford Research Institute. The standard observations for each month were provided to National Bureau of Standards as a part of the World Wide Data. Thai personnel assigned by MRDC are being trained by the USARPA people in Bangkok on the operation of the sounder equipment and preparation of the data reports.

5. USAECOM Representative in Bangkok

Captain Kenneth M. Irish, Jr. is on duty with the U. S. Army Electronics Command with duty station in Bangkok to provide on the spot contractual and technical assistance and guidance to ARPA R&D Field Unit, Jansky & Bailey, and Stanford Research Institute.

6. Problem Areas: None

7. USAECOM Procurement

a. The following items were procured and shipped to Bangkok, Thailand during this period:

(1) 5 ea Tires and Tubes for truck M37lBl
(2) 3 ea Tablets, malaria (bottle)
(3) 36 ea Batteries, mercury, Mallory
(4) 1 ea Signal Generator, 10 KC to 50 MC
(5) 1 ea Power Supply 24VDC
(6) 6 ea Rain Gauges and associated equipment
(7) 8 ea BEl 990 P VHF Radio Sets with associated equipment
(8) 75 ea Insecticide Bombs
(9) 6 ea Speaker Consoles, Collins
(10) 6 ea Wattmeters, directional, Collins
(11) 2 ea Radio Receivers R-390A
(12) 1 ea Field Intensity Meter
(13) 40,000 ft. Cable, twin lead 300 ohm
(14) Miscellaneous spare parts for M151 truck

b. The following items were procured and shipped to Saigon, Vietnam during this period:

(1) 6 ea crystal packet Collins CP-1
(2) 3 ea Microphone MM-1
(3) 3 ea Microphone MM-2
(4) 6 ea Antennas, dipole TD-1

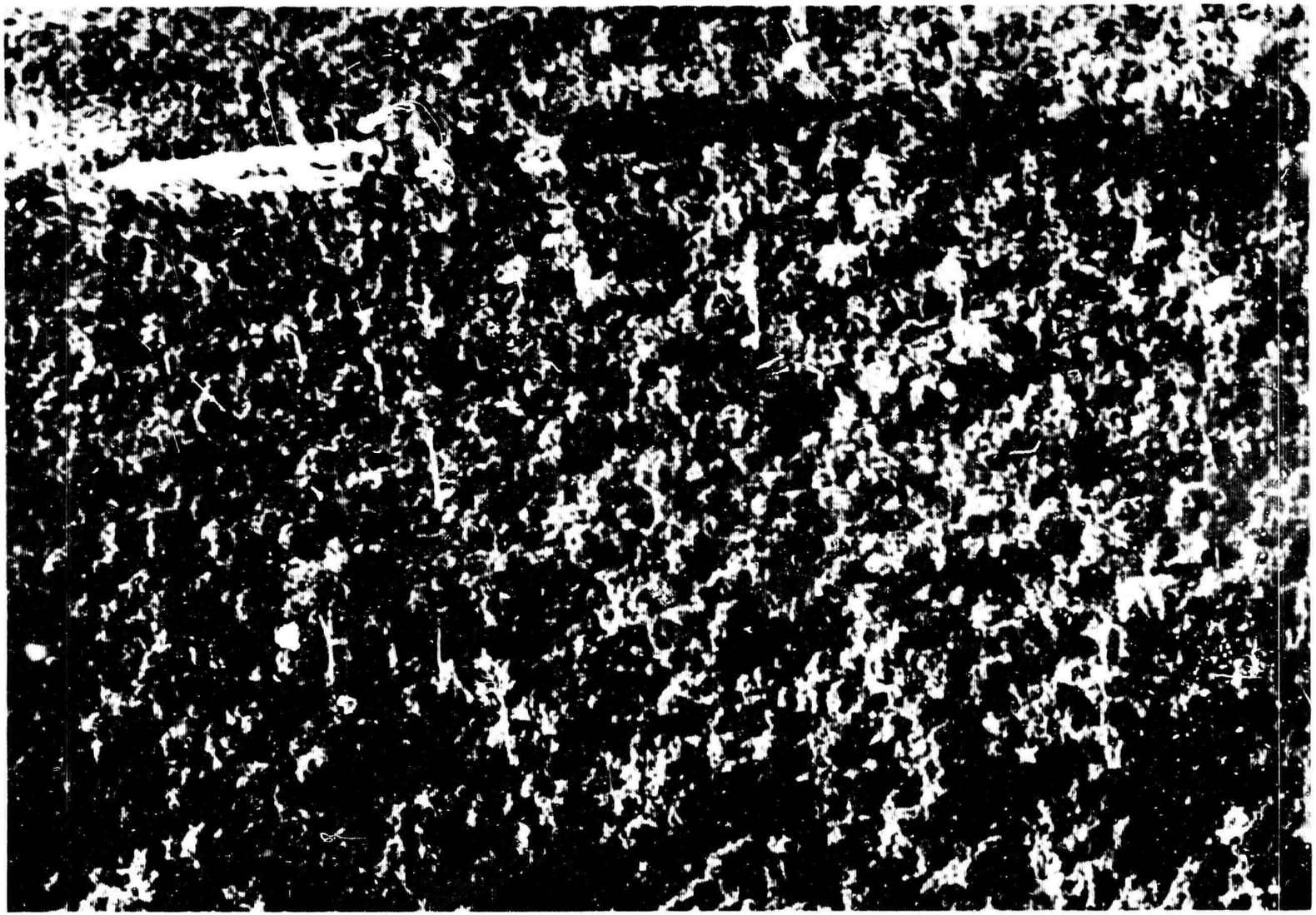

FIGURE I. AERIAL VIEW OF J&B SITE

FIGURE II. J&B TEST SITE

FIGURE III. ACCESS TRAIL DURING DRY SEASON

FIGURE IV. ACCESS TRAIL DURING WET SEASON

FIGURE V. ACCESS TRAIL DURING WET SEASON

FIGURE VI. NISSAN WITH FIBERGLAS PROTECTIVE CANOPY FOR ANTENNA

FIGURE VII. XELEDOP

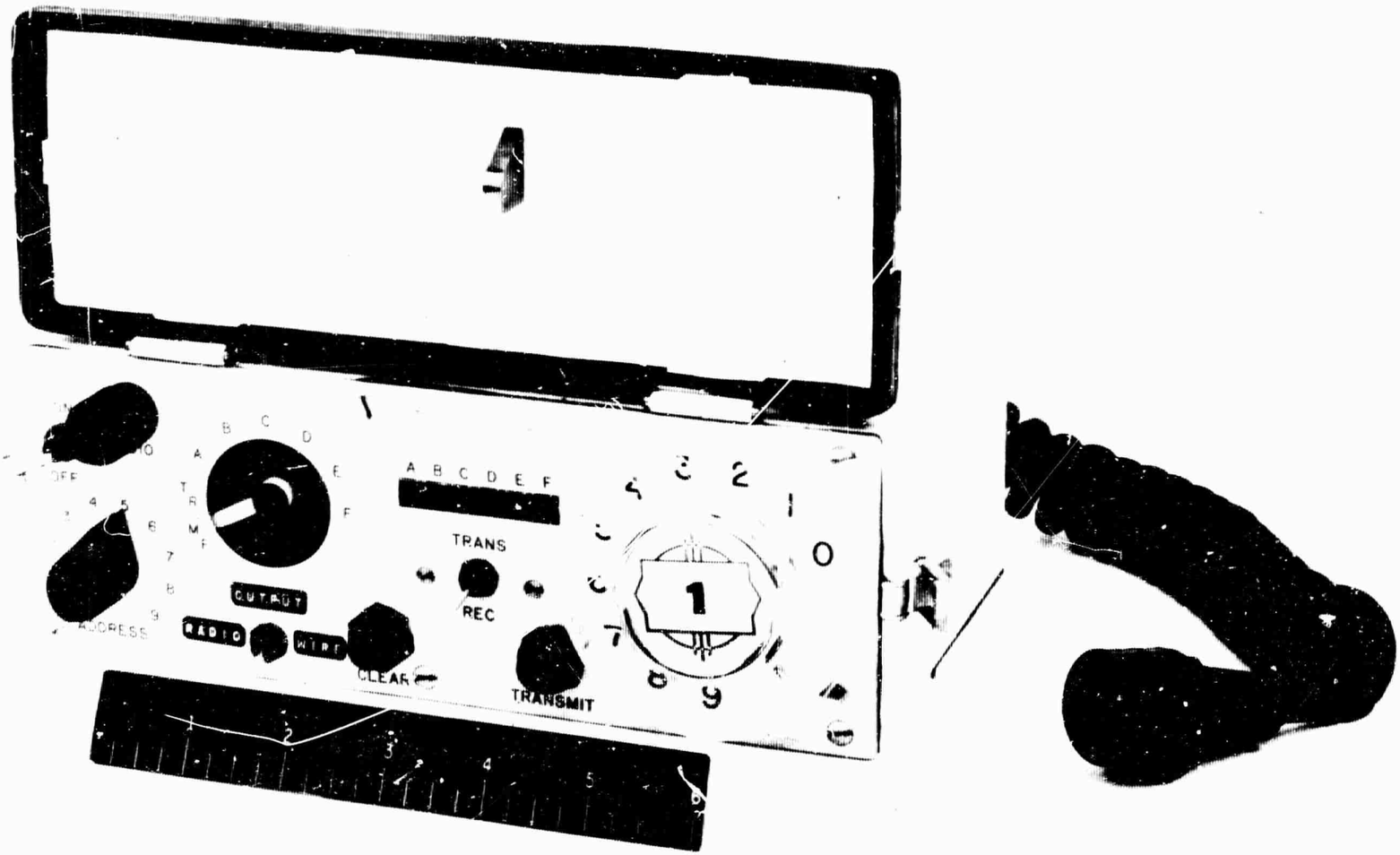

FIGURE VIII. DIGITAL ENCODER/DECODER

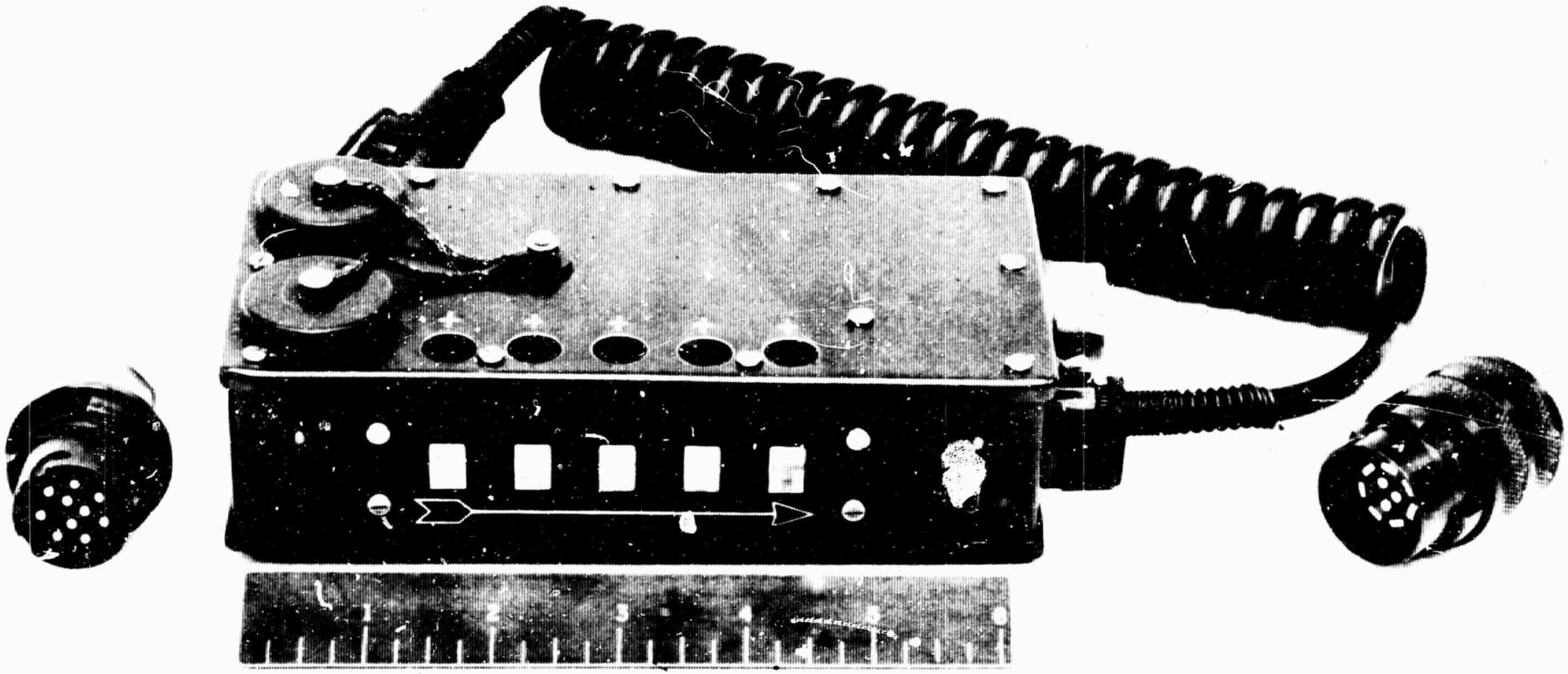

FIGURE IX. JUNGLE MESSAGE ENCODER/DECODER

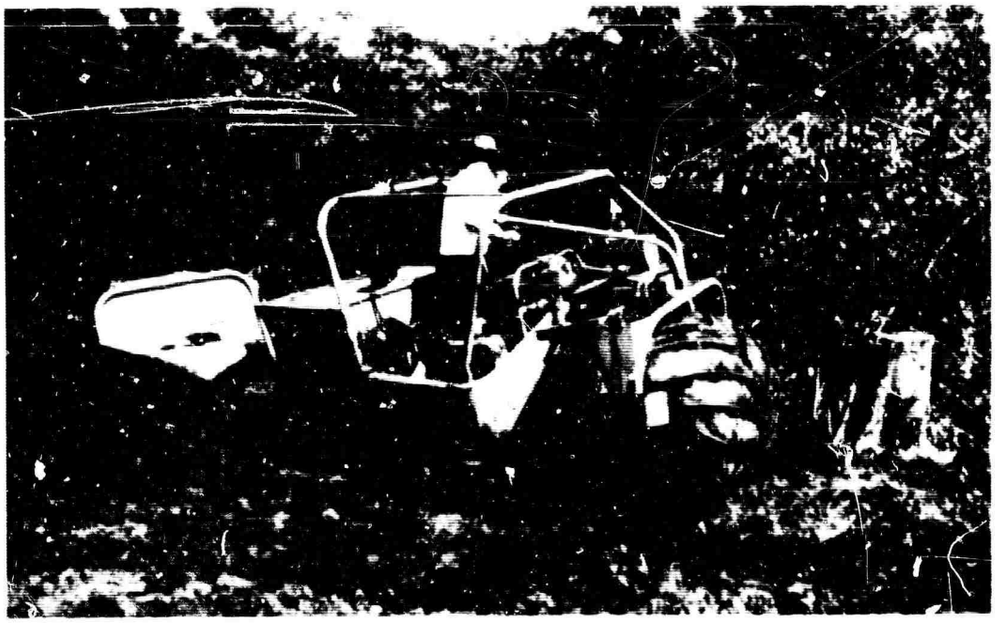

FIGURE X. ROLLIGON WITH NON-POWERED TRAILER

FIGURE XI. ROLLIGON WITH NON-POWERED TRAILER IN THAILAND

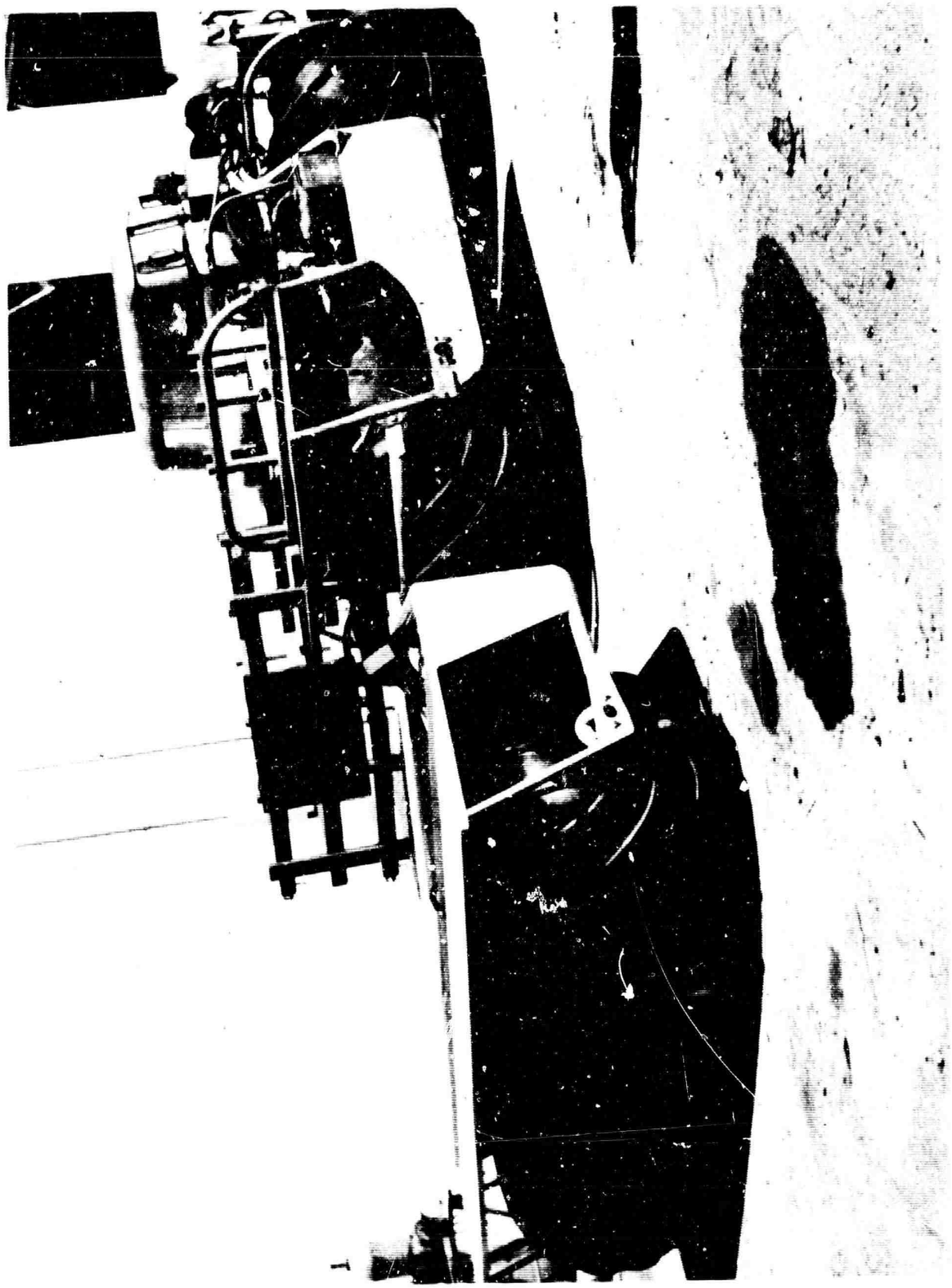

FIGURE XII. MODIFIED ROLLIGON WITH POWERED TRAILERS